Empathy Mirror

*Kang-Hao Chang
Department of EECS, University of California, Berkeley
kenghao@eecs.berkeley.edu

*Kai-Feng Cheng
Department of Architecture, CED
University of California, Berkeley
emeliech@berkeley.edu

*Sheng-Ying Pao
Deparment of Bioengineering,
University of California, Berkeley
pao@berkeley.edu

*the authors equally contributed
to this work

Corresponding Author
Kimiko Ryokai
School of Information, UC Berkeley
Kimiko@ischool.berkeley.edu

Abstract

We present the Empathy Mirror, a system that enhances users' ability to empathize with their intimate's feeling. We redesigned an ordinary everyday objects, a mirror, and established a new digital interface, behind which are facial expression recognition, data transmission and image manipulation technologies. The outcome of this project bridges the communication gap created by remote communication, such as telephone and online chatting.

Keywords

Empathy, affective computing, emotion regulation, ambient communication interface, tangible user interface.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

Communication is an essential component in our lives. By communicating with others, we share ideas, coordinate chores, improve relationship, and so on. However, oftentimes, it would be difficult for two persons to communicate if one cannot understand the other's situation or don't even want to try to understand: they lack a sense of empathy.

We propose Empathy Mirror, a new communication medium that helps people to communicate their emotion and stimulate *empathy* between people. We imagine, with the Empathy Mirror, people can start to empathize the others. They'll be self-motivated to call their friends, being patient to talk, listen, and try to understand their friend's situation.

Study [1] has shown that by observing the other's facial expression, people can catch other's emotion and empathize. The Empathy Mirror starts from this and moves forward. Instead of displaying your friend's face directly, the Empathy Mirror works by displaying your own face to stimulate empathy about the other: it displays your face with facial expression modified, as *your friend's emotion.*

The Empathy Mirror works as a *pair*, with some flavor of *intimate computing* [2]. One is put on your side and one is put on your friend's side. Each Empathy Mirror (1) captures the facial expression and recognizes the emotion of its owner, (2) exchanges the emotion with the other mirror through Internet connection, and (3) displays its owner's face but with the other's emotion.

We believe that your face with your friend's emotion would be more powerful than displaying your friend's face directly, to make you feel empathetic. The reason is that when you already don't understand your friend or don't even try to understand, your friend's face would somehow be less effective to make you feel her emotion. Instead, your face with your friend's emotion makes you to think about what it would feel like as if you are in your friend's emotion.

In the following sections, we first describe the related work. Then, we detail the system, interaction scenarios, and other possible applications. Before drawing the conclusion, we describe the preliminary user feedbacks and detailed evaluation plan.

Related work

There are many researches about the connection between emotion, facial expression and empathy, which serve as the foundation of this project. For example, Cohn [3] claimed that facial expression is an unobtrusive way for computers to perceive human's behavior and emotion. Watanabe et al. [4] studied how to control facial expressions of virtual robots to elicit sympathy. In addition, there are existing technologies for detecting facial expression [5] and morphing facial expression [6].

The *mirror interface*
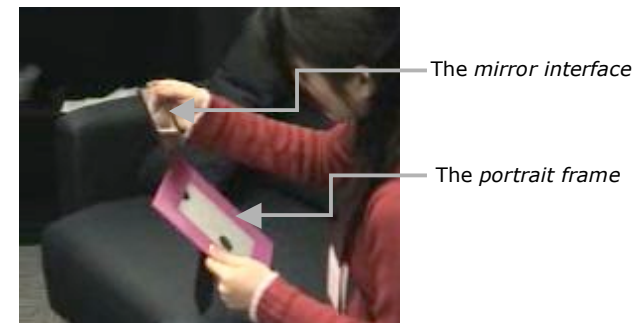
The *portrait frame*

figure 1. The two physical units of the Empathy Mirror, the *mirror interface* and the *portrait frame.*

The Empathy Mirror system

A primary design goal of the Empathy Mirror is to build an interactive system that allows users to better

understand each other's feelings and provides a reticent way of communication.

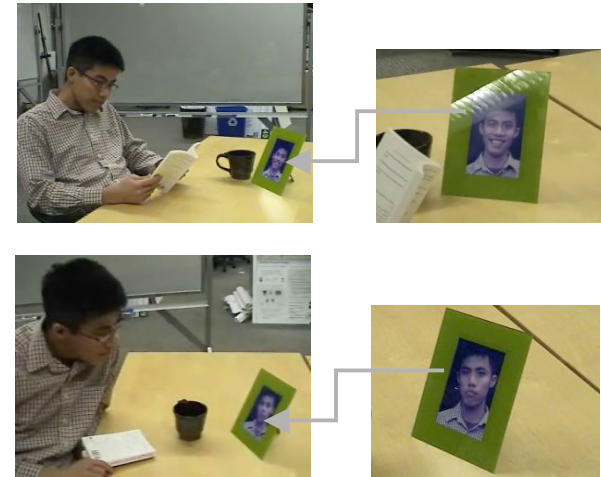*Mirror interface and Portrait frame*
The Empathy Mirror has two physical units (figure 1)-- mirror interface and portrait frame, which serve as a tangible user interface for users to switch the system between two distinct modes, the portrait mode (figure 2) and the mirror mode (figure 3). When the mirror interface is physically in the space behind the portrait frame, the system is kept in the ambient portrait mode, in which the portrait frame displays the user's portrait with the other user's facial expression. When a user picks up the mirror interface, the system will switch to the active mirror mode and capture the user's facial expression. The data will be transmitted to the other Empathy Mirror, and in turn changes the facial expression showing in the portrait of the other side. When the user inserts the mirror interface back into the portrait frame, the system is switched back to the ambient portrait mode. The emotion stays until the other user picks up the mirror interface and captures a new facial expression.

The metaphor of switching
The action of taking out the *mirror interface* from the *portrait frame* and inserting it back follows the metaphor of changing pictures. It mimics the way we draw out the old picture from the photo frame and insert a new one.

Furthermore, the action triggers the *transition* between two modes. From reflecting your own emotion while you hold it, to reflecting your friend's emotion after you put it back to the table, you'll see the difference, between you and your friend. You'll start to empathize,

starting to think about what it would feel like as if you are in your friend's emotion.


figure 2. When Empathy Mirror in the *portrait mode,* it is transparent in the physical environment. The photo in the portrait transforms according to the remote partner's emotion status.
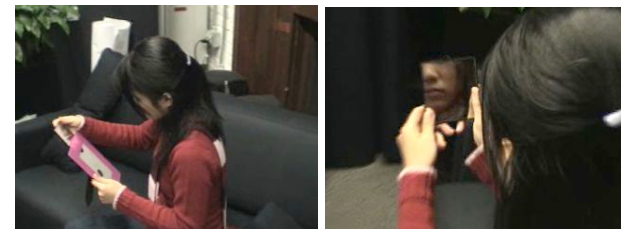
figure 3. Taking out the *mirror interface* from the *portrait frame* triggers the Empathy Mirror from the ambient *portrait mode* to the interactive *mirror mode.*

Components

The *mirror interface* incorporates a LCD screen and a CCD camera that captures the user's face and display it on the LCD screen in real-time. The processing unit computes and recognizes the facial expression, and the communication unit transmits the data to the *portrait frame* in the other Empathy Mirror system.
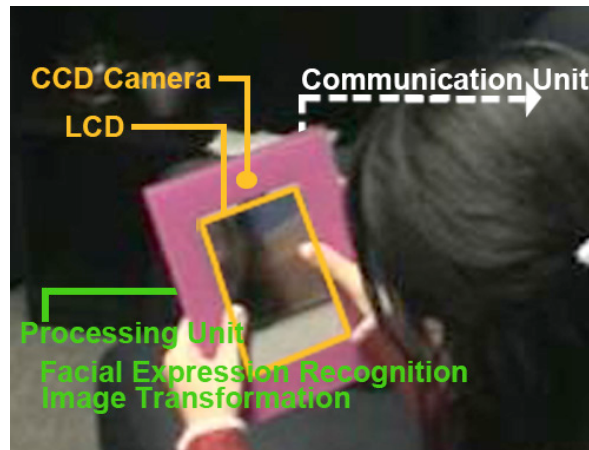
figure 4. The components behind Empathy Mirror.

The *portrait frame* consists of a LCD for displaying the portrait, a *communication unit* that accepting signals from the other Empathy Mirror system, and a *processing unit* that transform the facial expression in the portrait image. The systems need to be initialized by taking the users portrait with no significant emotion. Then every time when the *mirror interface* captures a new emotion, the *processing unit* will recognize the position of facial features and calculate the displacement between the current positions and those in the initial portrait. According to the information, the *processing unit* then applies the same level of displacement onto the positions of the facial features and consequently transforms the facial expression captured from the Mirror of one side to the portrait of the other side.

Scenarios

The Empathy Mirror enhances affective experience, provides a reticent way of communication, improves interaction between people in long distance, and may have applications on health care.

Affective Experience

Sometimes people don't understand each other's feeling. The Empathy Mirror helps people figure out the emotional status of the other. Two Empathy Mirrors are in a pair. Joe and his best friend, Kate, each has one of the mirrors. One day Joe's joke unwittingly hurt Kate. Joe kept laughing and ignored Kate's feeling because he thought it was only a joke. Afterward, Kate came home sadly and pick up her Empathy Mirror, hoping Joe would understand how she feels. The Empathy Mirror captures her sad face then changes Joe's facial expression in his portrait to be as sad as Kate's. When Joe finds out his sad face in his portrait, he feels like he is the same sad as Kate and realizes how vicious his joke was.

Reticent Communication

Now Joe feels sorry about his joke but it's too late. Kate refuses to answer Joe's call. Joe picks up the *mirror interface* in his Empathy Mirror. The mirror reflects his face with great worry. Kate's portrait is changed into the extremely unease expression of Joe's. She then believes that Joe really regrets. She feels better when knowing Joe understands her feeling. She picks up her

mirror, showing less sadness, but still not very happy. Joe realizes that his actions would cheer Kate up, so he picks up his Mirror again and makes a face to the mirror. Kate's face in her portrait turns so funny that she can't bear to laugh. She also picks up the mirror again and responses with a wry face. Joe laughs, and his laugh makes Kate's portrait laughs. Kate is influenced by her portrait and feels like she is as happy as Joe is. Kate picks up the mirror, sending a warm smile in return. Joe looks at his portrait with smile. He successfully, silently, efficiently solves the problem between them.

Other Applications

Long-distance Caring and Emotional Messaging
People usually share their emotions with the significant other. For couples in long-distance relationship, the Empathy Mirror serves as an emotional messaging system and shortens the distance between each other. They can still feel what the other feels. For students studying abroad, the Empathy Mirror serves as an ambient connection between them and their family. The background color of the portrait is changing according to the other part's time zone, temperature, and whether. The Empathy Mirror "puts oneself into another's shoes." People in long distance can easily perceive the emotion of another via interaction through the Empathy Mirror.

Health Care Applications

Autism and related conditions such as Asperger's syndrome are often (but not always) characterized by an apparent reduced ability to empathize with others. The function of Empathy Mirror that displays one's face with the other's facial expression will enable people with autisms spectrum disorders (ASD) to map others'

emotions to their own feelings, and help them create empathy.

Evaluation Method

The underlying hypothesis of the Empathy Mirror is that facial mimicry is a channel through which emotions may be transferred from one individual to another. In other words, by looking at one's face with other's facial expression, we would be able to read and to empathize with the other's feelings.

In order to validate this claim, we setup an open demonstration during class hours to gather preliminary feedbacks. We then propose an in-depth usability study to evaluate the Empathy Mirror in a more controlled setting.

Preliminary Feedback
We showcased the Empathy Mirror to our fellow classmates and some outside students during an open house session. We discussed the design ideas and introduced mockups of the system. Although it was not a controlled experiment, we were able to observe users' reactions to the Empathy Mirror and gauged their responses. The demos helped us understand the strength and the potential issues of the current system design. Below are summary of our observations and findings.

- Users agreed that empathizing with each other's feeling is a common communication problem and exists in their everyday life.
- Users quickly understood the interactions with the Empathy Mirror with little or no instruction.
- Users were intrigued to see their pictures changing.

▪ Users were eager to visualize their face with other people's facial expression.

User Evaluation Plan
To evaluate the Empathy Mirror in a more controlled setting, we propose the following evaluation plan. We will first recruit ten pairs of novice users. They can be couples, close friends, and/or families. The key criterion is that there has to be emotional attachment between each pair to some degree. We will recruit people with different gender, race, and age to cover a broad spectrum of users. We will keep the participants in the dark about the purpose of the test to avoid any preconception. We separate the evaluation into two stages.

FIRST STAGE: INITIAL DATA COLLECTION
We will give individual test subject an Empathy Mirror and ask them to place it in a location of their choice where they spend a substantial amount of time (e.g. office) for five days. The purpose of this stage is two-fold. On one hand, we want them to feel comfortable with the Empathy Mirror in their environment. In addition, we want to take photos of facial expressions that display genuine emotions. This will make it easier for the system to map subjects' emotions to their facial expressions. At the end of the 5 day period, the Empathy Mirror would've blended in with the environment and we should have enough raw images for our system to process.

SECOND STAGE: USABILITY DATA COLLECTION
For this stage, we will go to each subject's location of choice for experimentation. We will split the group into two groups; we call these two groups A and B. We will also split this stage into two halves, each last

approximately 4 hours. During the first half, group A's Empathy Mirror will display different emotional images from their own collection. Group B's Empathy Mirror will display emotional images from their partner's collection (if there aren't enough Empathy Mirror, we can always serialize this test). In the second half, the images will switch. During the course the day, we will give each subject a handhold device in which survey questions will pop up every thirty minutes. The subjects will identify their current emotion status, and describe the possible cause of their emotion change.

USABILITY DATA ANALYSIS
We will collect two sets of data: the first set is the user survey responses, and second set is the computer logs which records the emotions Empathy Mirror display with timestamps. By comparing and combining these two set of data, we are trying to find a correlation between user's emotions with those emotions displayed by the Empathy Mirror; thereby substantiating our hypothesis[1].

Conclusion
Empathy mirror is an in-progress project. In the future, we would like to examine the usability as we are planning and explore more possible scenario that the Empathy Mirror can be applied.

Comparing with other communication devices in the market, the Empathy Mirror has several advantages. First, it is an advanced tool that enables users to deeply comprehend their paired partner's feelings. By visually

---

[1] The reason we have two groups is to cancel out the effect of seeing emotional images of self first versus seeing emotional images of partner.

observing her/his own photo in the *portrait frame* transforming from one emotional status into another, it drives the movement of the user's facial muscle, and triggers their memory of this specific emotional condition. Users would have better communication based on their greater ability to understand each other's emotions.

Second, the Empathy Mirror also serves as a strong evidence that future digital interface should be seamlessly coupe with the physical environment. Like Mark Weiser wrote, "*The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.*" [7] The Empathy Mirror demonstrates a method to make digital interface transparent in our everyday life. Rethinking the metaphor of actions/ interactions and extending social affordance of ordinary objects will enrich our everyday life with digital experiences.

Acknowledgements

References

[1]   Robert M. Gordon. Sympathy, Simulation, and the Impartial Spectator, Ethics 1995.

[2]   Intimate Computing Workshop, http://www.paulos.net/intel/lab/ubicomp03/Workshop/index.htm

[3]   Cohn, J. F. Foundations of Human Centered Computing: Facial Expression and Emotion, ACM Int'l Conf. Multimodal Interface 2006.

[4]   Watanabe, A., Ogino, M., Asada,M. Mapping Facial Expression to Internal States Based on Intuitive Parenting, technical report 2007, Osaka University

[5]   Tian Y., Kanade, T., and Cohn, J. Facial expression analysis, Handbook of face recognition, S.Z. Li & A.K. Jain, ed., Springer, October, 2003.

[6]   Liu, Z., Shan, Y., Zhang,Z. Expressive Expression Mapping with Ratio Images, Siggraph 2007

[7]   Weiser, M. The computer for the 21st century. Scientific American, Vol. 265, No.3. (1991) 94-104